REGIONAL IMPACT AND SUSTAINABILITY ASSESSMENT OF HYDROPOWER – METHODOLOGY AND APPLICATION TO A SWISS CASE STUDIES

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Overview

The future of hydropower is a major challenge for sustainable development in many regions. Hydropower is the most important domestic source of energy in Switzerland, and constitutes an important local industry and backbone of regional economies in the Alps. It particularly generates income and employment as well as important fiscal revenues, but also affects the environment in those areas. In addition, Alpine hydropower plants with reservoirs provide an important capacity service to the national and international energy system by storing electricity between periods with peak supply and peak demand. At the same time, hydropower faces various challenges. Those involve the competing use of land and water resources between energy, tourism and agriculture, as well as uncertainties regarding energy markets and climate change. Finally, hydropower is a key element of the *Energy Strategy 2050* of the Swiss confederation, which requires to replace nuclear power. Hence, an expansion of hydropower is required, with investments in retrofitting and new plants.

In order to comprehensively evaluate the various effects of hydropower plants – both investments and operations –, an integrated impact and sustainability assessment is proposed and applied to selected case studies. This is based on a systematic appraisal of environmental, economic and social impacts in both the construction and operation phase, and the evaluation of trade-offs among the respective goals of sustainability and development from a stakeholder perspective. The former is ensured with a "technical" assessment and the latter through a stakeholder dialogue that are mutually integrated in an iterative process. This approach has been developed and tested with a case-study based setting in different Swiss Alpine regions. Accordingly, the methodological approach will be presented along with empirical results and insights for further development and applications, as well as policy recommendations.

Methods

Stipulated by the need of incorporating sustainability concerns into policy and project development, the search of adequate methods and tools that best help to evaluate and integrate the trade-offs and interactions between the economic, societal and environmental impacts has gained much attention in recent years. Around the world, sustainability assessment is emerging as a key decision-support tool. Based on a sustainable development perspective, it offers a complementary approach to other established methods and tools of impact assessment and project appraisal. However, despite a large body of literature, there is not a clear and uniform body of theory and methodology behind the majority of approaches that have been discussed and proposed. Rather, most contributions are based on different disciplinary and epistemological realms, and they primarily focus on specific aspects of sustainability assessment.

The purpose of sustainability assessment is to appraise and optimize projects with regard to the goals of sustainable development, ideally at an early stage of the planning process. In its most simple form, this is based on expert and stakeholder views about the effects of an undertaking upon various indicators in the three domains – environment, society and economy – on a predefined scale. However, this does not in general allow to separate between the effective impacts of a project and the stakeholders' concerns thereof. Therefore, we propose a modified approach of ***integrated sustainability assessment*** that combines in an iterative way a "technical" sustainability assessment and a stakeholder dialogue. Starting with a core group, the latter helps to identify at an early stage the main concerns and potential obstacles going along with the project and to elaborate mutual trust, which finally is important for successful realization of the project. In the further steps, environmental and socio-economic impact assessments shall provide information to the "technical" part of the sustainability assessment on a normalized scale for each indicator, while stakeholders are invited to evaluate the trade-offs among their different domains of concern through pairwise comparison or by directly expressing relative utility weights.

For our approach, we reviewed and adapted the existing grid of sustainability assessment of the Canton of Bern to the requirements of hydropower assessments. We divided the thre main domains environment, economy and society into a total of 15 sub-domains, and each sub-domain into two to five criteria with each one consisting of two to six indicators. Once the technical assessment will be completed on the indicator level, the stakeholders' utility weights will be used for aggregation.

Results

We first applied our approach to the "Lagobianco" project in Valposchiavo, a small valley in the southern part of the Swiss Alps. This retrofitting project shall replace an existing powerplant with reservoir by increasing the dam's height and building a new pumped-storage plant. In a first instance, opposition from environmental NGOs had stopped this project. As a consequence, a stakeholder dialogue had been launched, which resulted in an improvement of the project in all three domains of environment, economy and society. Building on this experience, a comprehensive environmental impact assessment as well as an update of an existing regional input-output table, a regional impact and sustainability assessment had been completed.

The first results of the sustainability assessment shows two distinct insights: During the operation phase, the expected net impacts are positive or neutral for all criteria (using equal weights for the aggregation of indicator results). For the construction, however, negative impacts are expected on most citeria in the environmental domain, whereas the impacts on economy and society are diverse. The next steps in this ongoing project are to verify the sustainability assessment with additional experts and stakeholders, and to determine differentiated utility weights in a further stakeholder workshop in the region. On criteria level, these weights will then be used for the aggregation of the technical assessment results into an integrated sustainability assessment.

In addition, a similar study with sustainability assessment and stakeholder dialogue is currently performed for a power plant in the hydropower cascade in Val Leventina, Ticino. The aim of this second study is to identify in a first round critical issues with regard to a prospective retrofitting project and and the reconcessioning of the plant. In addition, it shall help to optimize the project at an early stage. Altogether, the learnings from these two case studies help to test and improve the methodology and its implementation in further studies on hydropower and other energy projects.

Conclusions

A sustainability assessment and a stakeholder dialogue can both help improve ("optimize") a project and its acceptance within society. In order to identify critical issues, a conventional sustainability assessment can be useful at an early stage of the project, if stakeholders are involved. An *integrated sustainability assessment* (ISA) requires complete impact assessments in the environmental, economic, and social domains as a necessary basis of information, as well as differentiated utility weights that can be gained through the stakeholder dialogue. Altogether, this can help to reveal the social value of a project, and thus to provide additional information for energy policy and public investment, especially if the financial (private) value of the project is negative, as it is the case nowadays due to the currently low energy prices and small price spreads on the European market. A profound impact assessment and balanced evaluation of trade-offs are the keys to any successful and reliable ISA.

Altogether, this aims at providing better grounds for comprehensive, flexible and transdisciplinary sustainability assessment and decision making. The outcome must continuously be fed back and communicated to the stakeholders involved. Ideally, those include energy companies, investors, politicians, public administrations and non-governmental organizations as well as local citizens and businesses. Their involvement can particularly foster a critical dialogue about and higher acceptance of hydropower and other renewable-energy projects, as concrete experience underlines. However, the entire process is time consuming, and must rely on mutual trust. Moreover, applying it to an ongoing project might prove difficult, because stakeholders may want to defend positions they have achieved during the process earlier-on, and thus may try to avoid more transparent results. Nonetheless, we recommend ISA as a compulsory approach for large investment projects, such as hydropower plants in many places, and that it must be aligned with a social cost-benefit analysis, since both require the same information.